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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
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09/233,377      01/18/99      SANDHU

G      MI22-1114

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MM91/0119

EXAMINER

PHAM, T

ART UNIT

PAPER NUMBER

2813  
DATE MAILED:

9  
01/19/01

**Please find below and/or attached an Office communication concerning this application or proceeding.**

**Commissioner of Patents and Trademarks**

# Office Action Summary

Application No.  
09/233,377

Applicant(s)  
Sandhu et al

Examiner  
Thanhha Pham

Group Art Unit  
2813



☒ Responsive to communication(s) filed on Oct 30, 2000

☐ This action is **FINAL**.

☐ Since this application is in condition for allowance except for formal matters, **prosecution as to the merits is closed** in accordance with the practice under *Ex parte Quayle*, 35 C.D. 11; 453 O.G. 213.

A shortened statutory period for response to this action is set to expire 3 month(s), or thirty days, whichever is longer, from the mailing date of this communication. Failure to respond within the period for response will cause the application to become abandoned. (35 U.S.C. § 133). Extensions of time may be obtained under the provisions of 37 CFR 1.136(a).

## Disposition of Claim

☒ Claim(s) 10 and 21-51 is/are pending in the application.

Of the above, claim(s) 10, 27-39, and 46-51 is/are withdrawn from consideration.

☐ Claim(s) \_\_\_\_\_ is/are allowed.

☒ Claim(s) 21-26 and 40-45 is/are rejected.

☐ Claim(s) \_\_\_\_\_ is/are objected to.

☐ Claims \_\_\_\_\_ are subject to restriction or election requirement.

## Application Papers

☐ See the attached Notice of Draftsperson's Patent Drawing Review, PTO-948.

☐ The drawing(s) filed on \_\_\_\_\_ is/are objected to by the Examiner.

☐ The proposed drawing correction, filed on \_\_\_\_\_ is ☐ approved ☐ disapproved.

☐ The specification is objected to by the Examiner.

☐ The oath or declaration is objected to by the Examiner.

## Priority under 35 U.S.C. § 119

☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

☐ All ☐ Some\* ☒ None of the CERTIFIED copies of the priority documents have been

☐ received.

☐ received in Application No. (Series Code/Serial Number) \_\_\_\_\_.

☐ received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

\*Certified copies not received: \_\_\_\_\_

☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

## Attachment(s)

☒ Notice of References Cited, PTO-892

☒ Information Disclosure Statement(s), PTO-1449, Paper No(s). 3, 6

☐ Interview Summary, PTO-413

☐ Notice of Draftsperson's Patent Drawing Review, PTO-948

☐ Notice of Informal Patent Application, PTO-152

--- SEE OFFICE ACTION ON THE FOLLOWING PAGES ---

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## DETAILED ACTION

### *Election/Restriction*

1. Applicant's election without traverse of 21-26 and 40-45 in Paper No. 8 is acknowledged.
2. Claims 10, 27-39, and 46-51 are withdrawn from further consideration pursuant to 37 CAR 1.142(b) as being drawn to a nonelected group, there being no allowable generic or linking claim. Election was made **without** traverse in Paper No. 8.

### *Claim Rejections - 35 USC § 102*

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless --

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371© of this title before the invention thereof by the applicant for patent.

3. Claims 21, 23, and 25 are rejected under 35 U.S.C. 102(e) as being anticipated by Hu et al [US 5,874,351].

Hu et al, figs 1-6 col 1-6, discloses the claimed method of forming a refractory metal silicide comprising steps:

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forming a refractory metal silicide ( $\text{TiSi}_x$ ) of a first crystalline phase (16, fig 3);  
providing a compressive stress inducing atoms (implanting e.g. W) within the refractory metal silicide of the first crystalline phase;

with the compressive stress inducing atoms within the first phase refractory metal silicide, annealing the refractory metal silicide of the first crystalline phase under conditions effective to transform said silicide a to a more dense second crystalline (20, fig 5).

4. Claims 40-41 and 45 are rejected under 35 U.S.C. 102(a) as being anticipated by Kawamura et al [JP 8139056].

Kawamura et al teaches the claimed method of forming a refractory metal silicide comprising steps:

forming a refractory metal (5, Ti, fig 5B) on a silicon containing substrate;  
providing a compressive stress inducing material (10 & 9, fig 5B) proximate the refractory metal;

after providing the compressive stress inducing material, annealing the refractory metal to form a refractory metal silicide of a first crystal phase ( $\text{TiSi}_x$  C49) from the refractory metal and silicon of the underlying substrate; and

annealing the refractory metal silicide of the first crystalline phase to transform the first phase silicide to a more dense second crystalline phase ( $\text{TiSi}_x$  C54).

With respect to claim 45, see fig 5B providing the compressive stress inducing material (10 & 9) under the first crystalline phase refractory metal silicide.

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5. Claims 40-44 are rejected under 35 U.S.C. 102(e) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Apte et al [US 5,593,924].

Apte et al, figs 1-6 col 1-4, teaches the claimed method of forming a refractory metal silicide comprising steps:

forming a refractory metal (20, Ti, fig 2) on a silicon containing substrate;

providing a compressive stress inducing material (22, silicon nitride, fig 2) over the refractory metal;

after providing the compressive stress inducing material, annealing the refractory metal to form a refractory metal silicide of a first crystal phase ( $\text{TiSi}_x$  C49, fig 3) from the refractory metal and silicon of the underlying substrate; and

annealing the refractory metal silicide of the first crystalline phase to transform the first phase silicide to a more dense second crystalline phase ( $\text{TiSi}_x$  C54 fig 5, col 3 lines 49-67 and col 4 lines 1-29).

With respect to claim 42, see col 3 lines 49-59, Apte et al teach providing the compressive stress inducing material within the first crystalline phase refractory metal by implanting Ge or As.

With respect to claim 44, range thickness of compressive stress inducing material (36 or 22) over the first crystalline phase refractory metal silicide is considered to involve routine experimentation and would not yield unexpected result.

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***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

6. Claims 22, 24 and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hu et al [US 5,874,351].

With respect to claim 22, Hu et al does not expressly teach the first crystalline phase (16) being of C49 and the second crystalline phase (20) being of C54. Since, it has been well-known in the art that a process of annealing  $TiSi_x$  of the first crystalline phase C49 to transform to  $TiSi_x$  of the second crystalline phase C54 wherein the  $TiSi_x$  C54 maintains a good low resistivity. It would have been obvious for those skilled in the art to use the process of Hu et al to transform the  $TiSi_x$ -C49 to the  $TiSi_x$ -C54 with lower resistivity for a better semiconductor device.

With respect to claim 24, in situ providing atoms into a refractory metal layer during deposition of the refractory metal layer over an underlying silicon containing substrate and annealing the refractory metal layer to form the refractory metal silicide of the first crystalline phase is a well-known technique for making refractory metal silicide. It would have been obvious for those skilled in the art to use either sputtering technique (as being taught by Hu et al) or the claimed technique (in situ providing compressive stress inducing atoms into a refractory metal layer during deposition of the refractory metal layer over an underlying silicon containing

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substrate and annealing the refractory metal layer to form the refractory metal silicide of the first crystalline phase) to form the refractory metal silicide with the first crystalline phase in the process of Hu et al before transforming the first crystalline phase to the second crystalline phase structure with a lower resistivity.

With respect to claim 26, range of concentration of compressive stress inducing atoms within the refractory metal silicide is considered to involve routine optimization while has been held to be within the level of ordinary skill in the art. As noted in *In re Aller*, the selection of reaction parameters such as temperature and concentration would have been obvious.

“Normally, it is to be expected that a change in temperature, or in concentration, or in both, would be an unpatentable modification. Under some circumstances, however, changes such as these may be impart patentability to a process if the particular ranges claimed produce a new and unexpected result which is different in kind and not merely degree from the results of the prior art...such ranges are termed “critical ranges and the applicant has the burden of proving such criticality... More particularly, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation.”

*In re Aller* 105 USPQ233, 255 (CCPA). See also *In re Waite* 77 USPQ 586 (CCPA 1948); *In re Scherl* 70 USPQ 204 (CCPA 1946); *In re Irmischer* 66 USPQ 314 (CCPA 1945); *In re Norman* 66 USPQ 308 (CCPA 1945); *In re Swenson* 56 USPQ 372 (CCPA

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*1942); In re Sola 25 USPQ 433 (CCPA 1935); In re Dreyfus 24 USPQ 52 (CCPA 1934).*

Therefore, one of ordinary skill in the requisite art at the time of invention was made would have used any concentration range suitable to the method Hu et al in order to optimize the process.

### ***Conclusion***

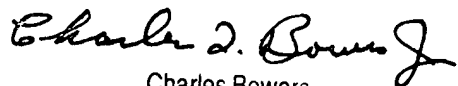
Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thanhha Pham whose telephone number is (703) 308-6172. The examiner can normally be reached on Monday-Friday from 9:30 AM to 6:00 PM.

If attempts to reach the examiner by telephone are unsuccessfully, the examiner's supervisor, Charles Bowers, can be reached on (703) 308-2417. The fax phone number for the organization where this application or proceeding is assigned is (703) 308-3432.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

TSP

January 12, 2001



Charles Bowers  
Supervisor Patent Examiner  
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